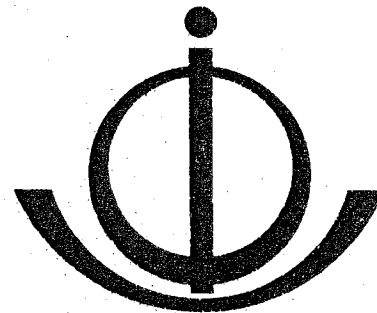


INTERNATIONAL TSUNAMI INFORMATION CENTER



INTERGOVERNMENTAL OCEANOGRAPHIC COMMISSION
COMMISSION OCEANOGRAPHIQUE INTERGOUVERNEMENTALE
COMISSIÃO OCEANOGRÁFICA INTERGOVERNAMENTAL
МЕЖПРАВИТЕЛЬСТВЕННАЯ ОКЕАНОГРАФИЧЕСКАЯ КОМИССИЯ

P. O. Box 3650, Honolulu, Hawaii 96811 USA

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NEWSLETTER

The ITIC Newsletter brings news and information to tsunami researchers, engineers, educators, community protection agencies and governments in 36 countries. We welcome your news, reports, papers, or abstracts.

Hawaii Tsunami of November 29, 1975

The island of Hawaii, whose volcanoes Mauna Loa and Kilauea have been threatening to erupt, was rocked by two earthquakes on the morning of November 29. The first, magnitude 5.5 with epicenter near the Kilauea crater, occurred at 3:35 a.m. local time, and roused residents throughout the Island. Just over an hour later a second quake, magnitude 7.2, occurred immediately off the southeast coast and generated a tsunami.

Waves, cresting from 20-30 feet above high tide, swept local campsites at Halape Beach where 36 people were spending the Thanksgiving holiday weekend. One man was killed, a second is missing and presumed dead, and others were hospitalized with minor injuries.

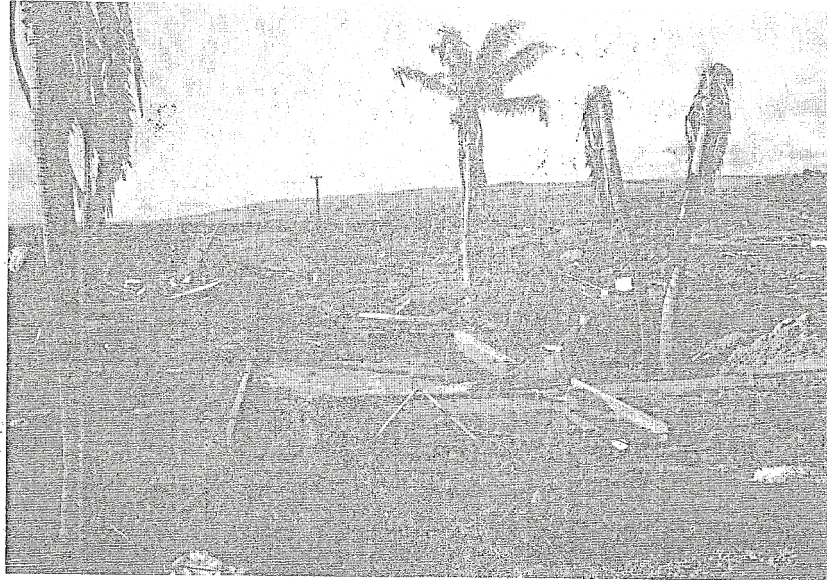
Homes were destroyed at Punaluu, where the tsunami travelled inland as much as 150 yards. Waves swung around the south and east points of the Island, to strike at harbors near Kona and at Hilo. Dock facilities and boats sustained damage at Keauhou, on Hawaii's Kona coast. Boats were sunk or damaged at Hilo, where a wave crest in the Wailoa River mouth reached about 12 feet.

In addition to the tsunami, damage was sustained from the earthquake itself. Buildings in many localities were severely shaken, roads were cracked, and some were rendered impassable by landslides. Electrical power to many areas was disrupted.

Police and Civil Defense on the Island responded directly to the earthquake, and began evacuation of residents from low lying areas. Work crews began restoring power and reopening communications promptly. Army helicopters airlifted injured to hospitals, and were used in warning isolated areas.

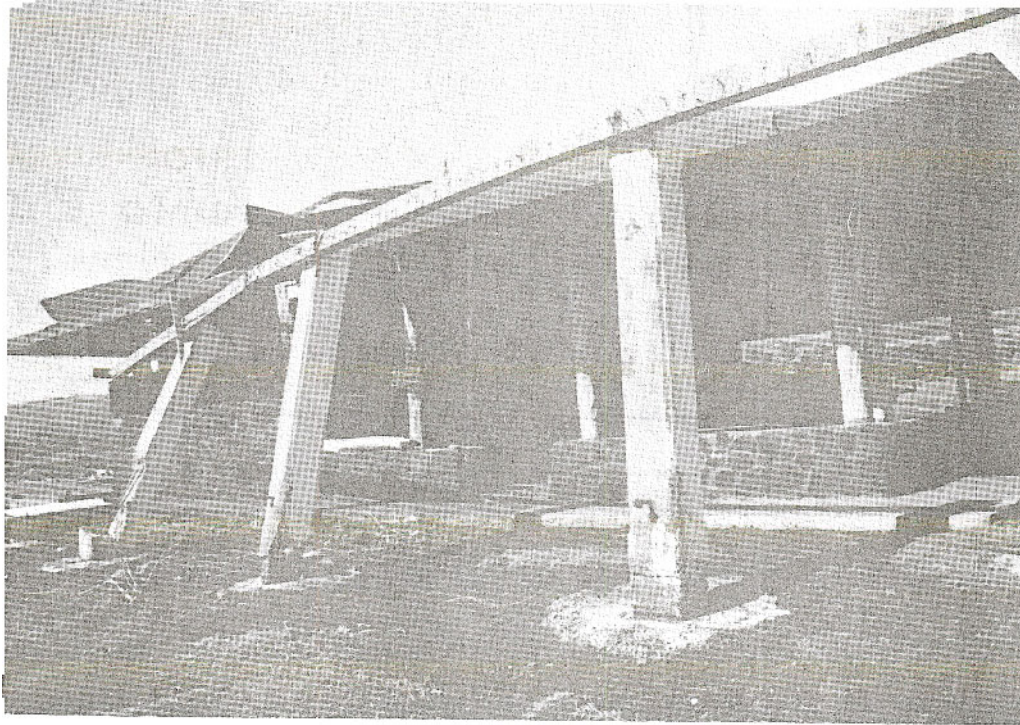
Queries were sent by the Honolulu Observatory at the time of the earthquake to gauge stations at Johnston and Kwajalein Islands, and both reported no tsunami.

George Pararas-Carayannis and Dennis Sigrist of ITIC arrived from Honolulu the afternoon of the tsunami, and with Sydney Wigen who had come to Hilo the previous day, surveyed tsunami effects and run-up around the Island.

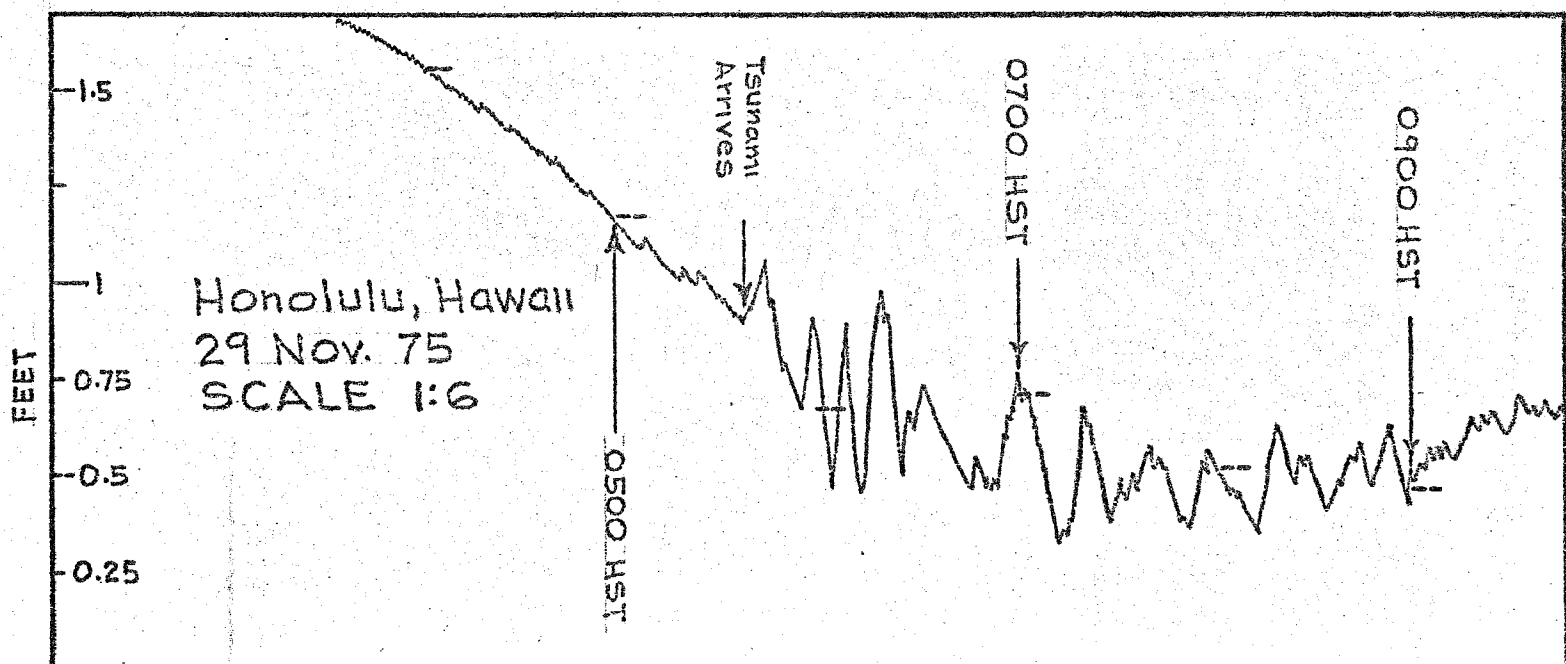
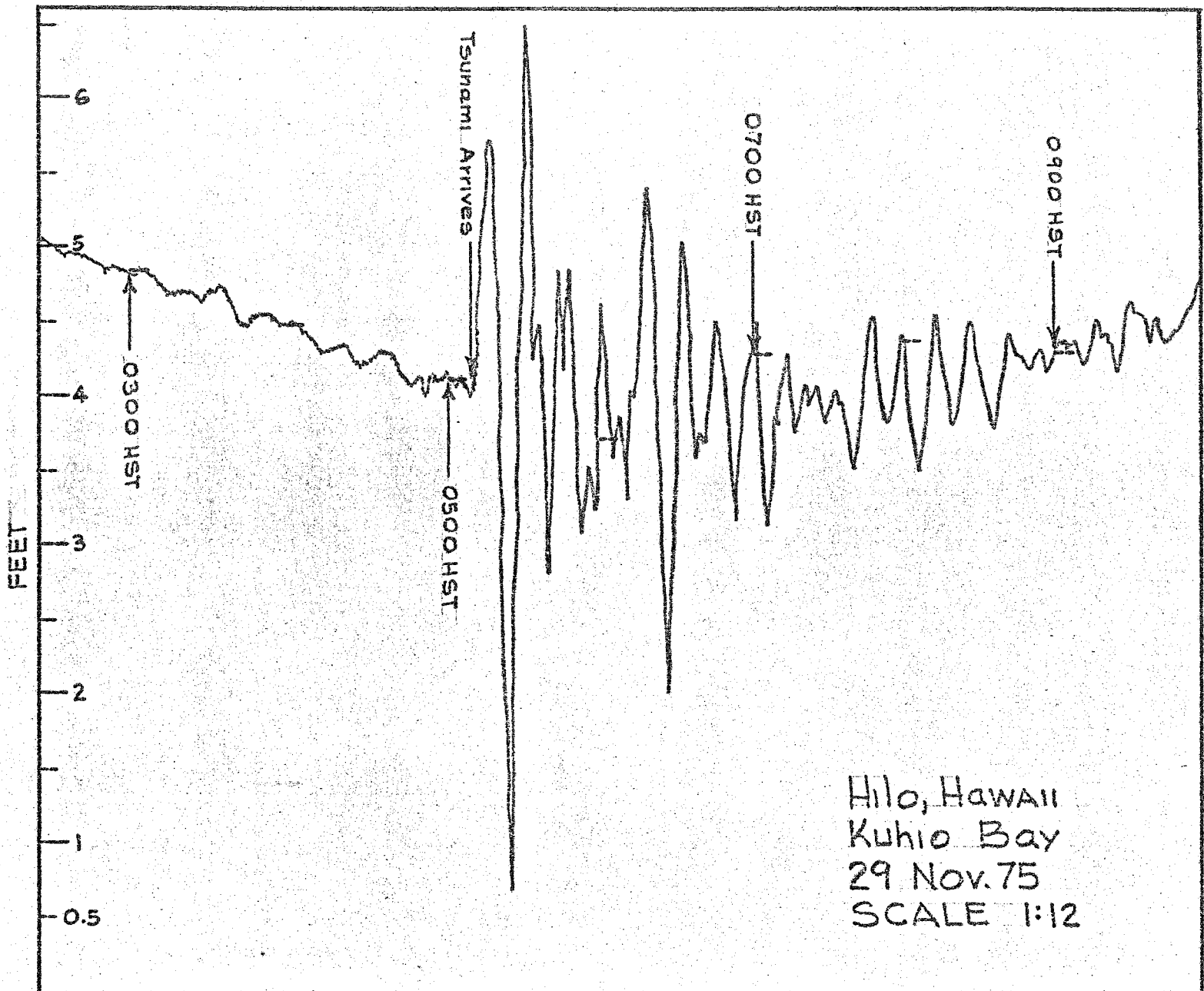


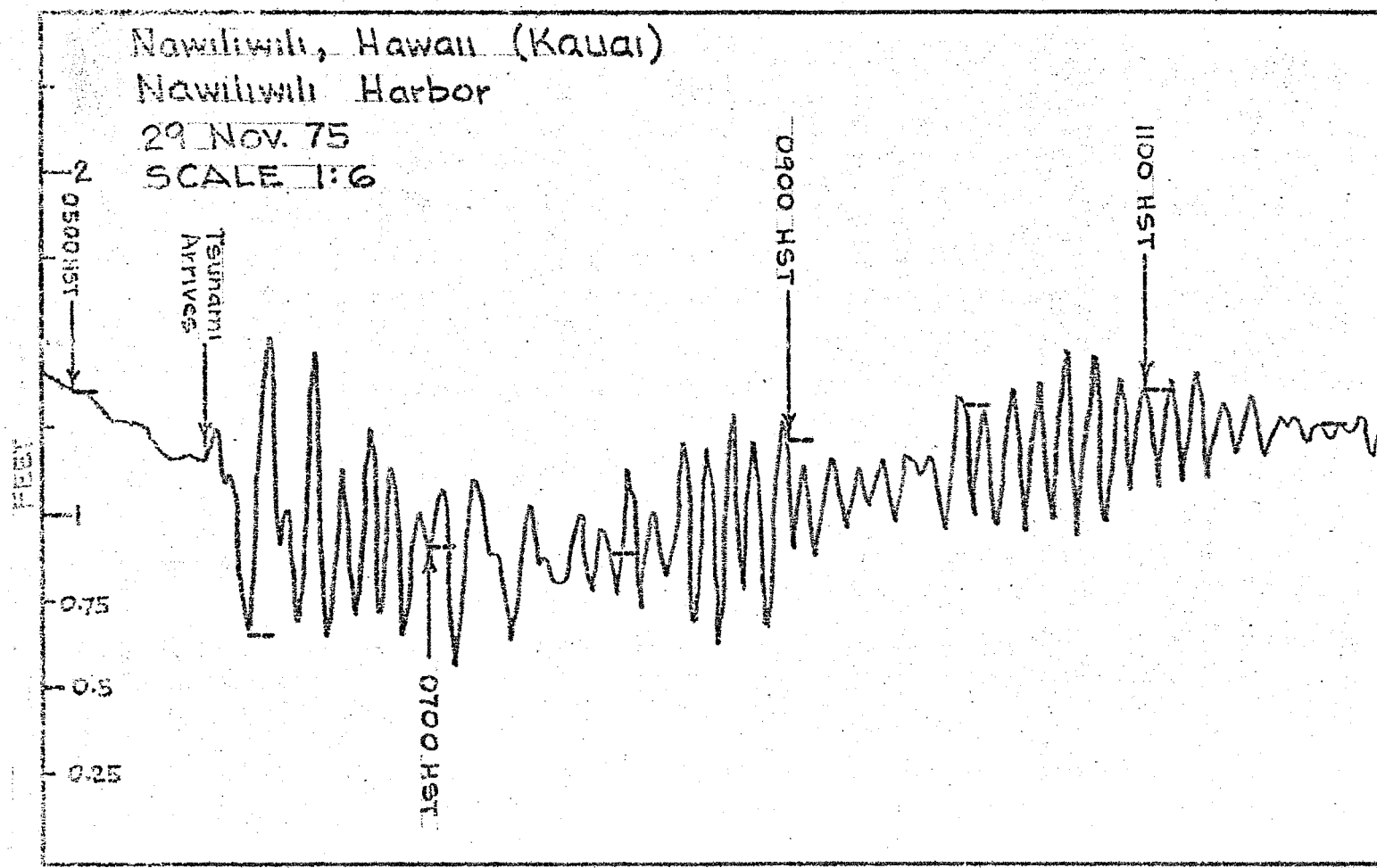
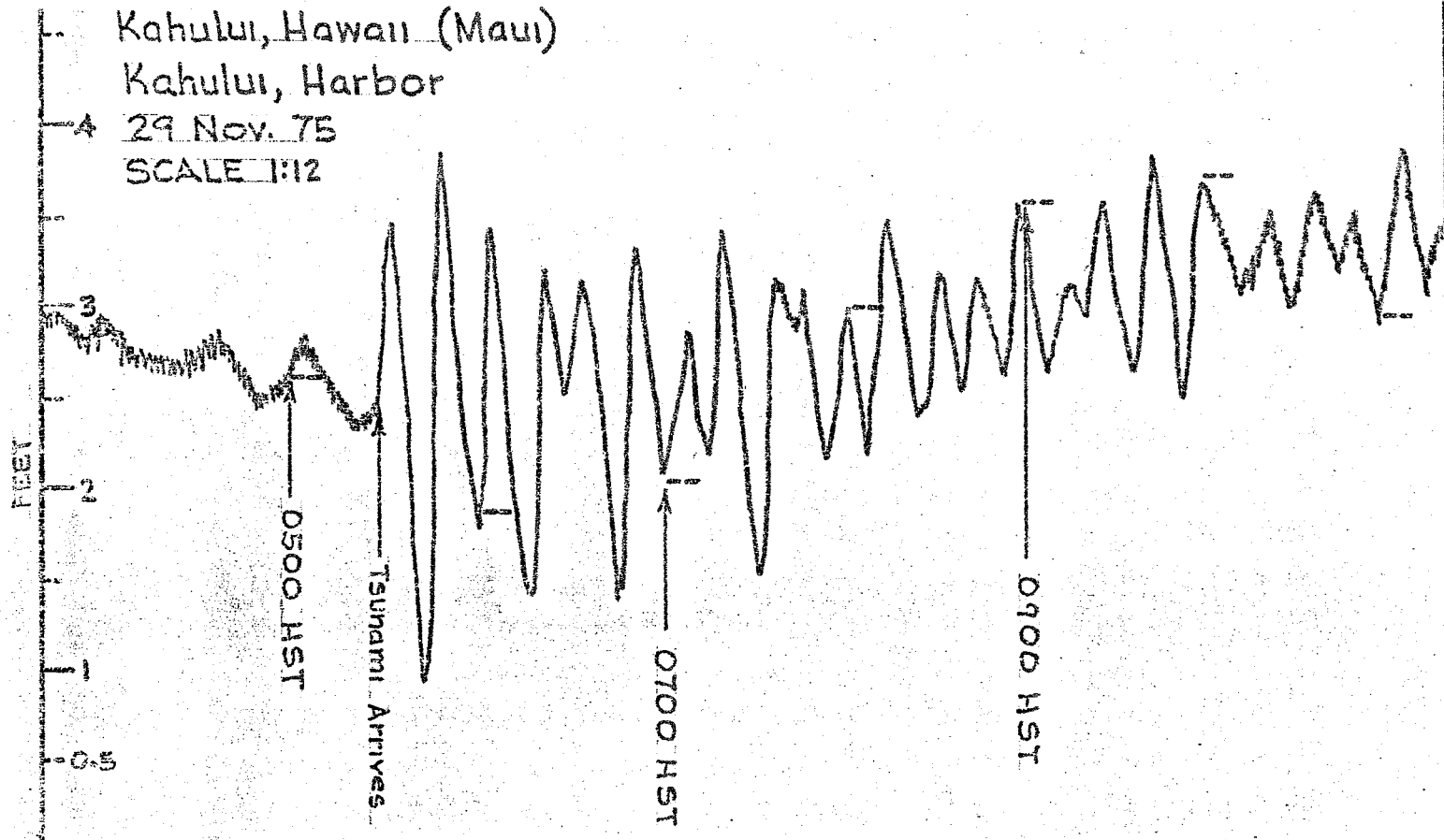
NOVEMBER 29, 1975 TSUNAMI DAMAGE, ISLAND OF HAWAII. Seven residences were destroyed at the Punalu'u area of the Big Island resulting from the tsunami generated by the earthquake centered off Kalapana, Hawaii on November 29, 1975. Most of the houses were carried off their foundations by the second wave, said to be the largest, and carried inland 13. considerable distance. Coconut palm trees were also severed by the destructive force of this tsunami, only the second locally generated wave since the tsunami resulting from the great earthquake of 1868. Damage at the Punalu'u area was estimated to be in excess of one million dollars.





This beach pavilion, located at Punalu'u, has survived three tsunamis previous to this recent event of November 29, 1975. The four concrete, steel-reinforced beams located to the front of the pavilion were either toppled or bent severely due to the force of this tsunami.





Throughout the Hawaiian Islands the following maximum wave heights were recorded at tidal stations:

Hilo, Hawaii	5.7 feet
Kahului, Maui	3.0 feet
Honolulu, Oahu	0.6 feet
Mokuoloe, Oahu	0.1 feet
Nawiliwili, Kauai	0.9 feet

The staff of ITIC is in the process of compiling a report on the tsunami effects in Hawaii and elsewhere.

Editors Note

In the September 1975 issue of the ITIC Newsletter, we erroneously implied that the island of Bougainville is part of the British Solomon Islands when it is in fact under the government of Papua New Guinea.

To all concerned we express our apologies, and also our appreciation to those who drew the error to our attention.

Earthquake in Guam - November 1, 1975

One of the worst earthquakes in the history of Guam Island, occurred Saturday morning, November 1. The earthquake's epicenter was located about 160 miles north of Guam and apparently was a deep focus event as the island of Saipan, just to the north of Guam, was barely affected by the tremor. Apparently no tsunami, local or Pacific-wide, was generated by this quake that measured 6.25 on the Richter scale.

Damage to buildings and property at Guam was widespread along with associated power outages at various parts of the island. Only one known minor injury occurred, according to local sources, even though many structures were badly cracked, including many business premises. The last earthquake of similar intensity shook the island on October 10, 1936.

GOES-1 Successfully Launched

A new satellite of potentially great significance to the Tsunami Warning System was successfully launched from the Kennedy Space Center on October 16, by a NASA Delta rocket. The satellite, designed to monitor both the earth's environment and solar activity, achieved a good earth-stationary orbit over the equator at 35,800 kilometers and joined the SMS 1 and SMS 2 satellites operated by NOAA for environmental monitoring and data transmission. GOES-1 (for Geostationary Operational Environmental Satellite-1), will provide scientists with pictures of about one-quarter of the Earth at 30-minute intervals, day and night. Both visible light and infrared pictures will be relayed during the day, and infrared at night.

Equipment aboard the satellites collect and relay non-visual environmental data, as well, from numerous remote sensing facilities on land and at sea. Some of these sensing facilities could be tide and seismic devices for the Tsunami Warning System.

From the mass of pictures and environmental information supplied by GOES-1, meteorologists, oceanographers and other scientists will be provided near-instantaneous information for such uses as weather detection and prediction, observing ocean currents, monitoring river water levels, or predicting the occurrence of tsunamis.

GOES-1 systems were satisfactorily checked out in a 16-day period following the launch, and it is now being put into service at Longitude 75 degrees West. SMS 1 will be placed on standby, and SMS 2 is being shifted from 115 to 135 degrees West, a strategic location for serving the tsunamigenic areas of the Pacific.

REPORTS FROM ITIC - HONOLULU

Visiting Scientists to ITIC

Two scientists have been selected by the Intergovernmental Oceanographic Commission (IOC) to visit the International Tsunami Information Center. They are Mr. Pedro Cabezas Gonzales from Ecuador and Mr. Cesar Vargas Faucheux from Peru. Mr. Vargas arrived at the beginning of November for a six-week working visit to ITIC and the Pacific Region. He is presently assisting with the writing of a proposal to the United Nations Development Program for support in establishing a regional tsunami warning system in South America. This project is coordinated by ITIC at the direction of IOC and in agreement with the South American countries involved.

Soviet Scientist Visits JTRE

During the past six weeks, Dr. Alexei Ivashchenko, from the Sakhalin Complex Scientific Research Institute has been visiting the Joint Tsunami Research Effort, and ITIC and its Honolulu Observatory. The purpose of his visit was to develop a scheme for location of earthquakes from a single seismic station. Distance is to be obtained from the emergence angle of the wave and azimuth from the spectral characteristics of the seismogram. Dr. Ivashchenko first stopped at Environmental Research Laboratories, NOAA, Boulder, Colorado to obtain digitized seismograms as input data. He then continued on to JTRE, where he wrote a computer program which fits a model to the spectral characteristics of the seismograms.

Acknowledgement

We would like to acknowledge the help and co-operation being given to ITIC by individuals and agencies engaged in research and in observational programs throughout the Pacific and elsewhere, in providing systematic knowledge and interpretation of tides and tsunamis, and of seismic and tectonic activities. Most recently we have received from many tidal authorities and researchers in Australia and in Papua New Guinea, comprehensive data and detailed replies that will be of great value in assessing the vulnerability of these regions to tsunamis.

TSUNAMI WARNING SYSTEM IN THE PACIFIC

Tsunami Exercise

Eleven years have elapsed since the last Pacific wide tsunami struck the Hawaiian Islands. Many people in responsible positions have not experienced the devastation and the civil emergencies that can be created by these waves.

In order to maintain an awareness and competence in dealing with such a natural disaster, the State Civil Defense of Hawaii held a training exercise on November 14th.

Approximately 100 people who would act in a tsunami emergency assembled at the Birkhimer Emergency Operating Center, in Diamond Head, in Honolulu. Each had previously received and read a scenario simulating a tsunami watch and warning, resulting from an earthquake near Adak. In this scenario, times of warnings, and Civil Defense operations were announced. Emergency facilities and offices were reported staffed and the alerting of the civilian population was described. Arrival of waves and damage situations were reported.

Major General Valentine A. Siefertmann, Director of Hawaii's Civil Defense, welcomed the participants to the exercise, and defined its purpose in stating, "Civil preparedness for any type of disaster is a never-ending task. Collaterally it is everyone's job - in all departments - at all levels - in every household. Our mission here today is to review our responsibilities as members of the community. What should we do under a given set of circumstances - and are we prepared to cope with the problem?"

Four presentations placed tsunamis into realistic perspective. Dr. Gaylord Miller, Director of the Joint Tsunami Research Effort, described earthquake movements which generate tsunamis, how the waves travel over oceans, and how they run up onto coasts. A movie "Tsunamis, Observations, Computations, and Hydraulic Models" illustrated the arrival of waves from recent tsunamis in the Hawaiian and the Kuril Islands in USSR. Dr. George Pararas-Carayannis, Director of ITIC, showed the operations of the Tsunami Warning System, and the functions of the Honolulu Observatory. Dr. Harold Loomis gave a graphic presentation of the response of harbours to a variety of tsunamis, the dangers from currents as well as from flooding, and the near impossibility of predicting local effects.

Robert E. Schank, Intelligence and Education Officer, outlined the role of State Civil Defense, the mechanics of watch and warning, and the communications used to involve first the officials, and then if necessary, the public.

Robert E. Sorg, Economic Resources Mobilization Officer, described the resources available to cope with an emergency, and sources of funding and other aid available to recover from tsunamis and other disasters.

Neill T. Williams, Operations and Training Officer, and Lawlor M. Reck, Training Specialist, divided the participants into teams to analyze the problems accompanying the tsunami and identify priorities. Conclusions were then compared in a combined session. The 4-hour exercise concluded with a tour of facilities, and lunch provided by the State Civil Defense.

Copies of the working papers used in the exercise may be obtained by writing to the ITIC Newsletter.

Persons planning to visit Hawaii who wish a tour of State Civil Defense Facilities are invited to write Director of Civil Defense, State of Hawaii Civil Defense Division, Building 24, Fort Ruger, Honolulu, Hawaii 96816.

Testing of Tsunami Sensors

The Ocean Services Division of the National Weather Service will begin testing the GOES (Geostationary Orbital Earth Satellite) tsunami tide gage monitoring platform this month in San Diego. This sophisticated system, using small radio transmitters, will relay tidal data via the GOES synchronous satellite on a real time basis. If testing of this system proves successful, it will pave the way for a Pacific-wide tide monitoring system, for tsunami warning purposes. Ultimately, the system will also relay real-time seismic data as well as providing communications, in the form of tsunami bulletins, to remote areas of the Pacific. The test of this system is expected to take 6 months with the possibility, upon completion, of transferring equipment to Oahu, Hawaii, for further testing with other tide monitoring systems.

Tsunami Warning System Co-ordination Meeting

A 4-day meeting to review the operations and commitments of the United States in the Tsunami Warning System was held in Honolulu December 8-11. The meeting was called by Mr. Karl R. Johannessen, Associate Director, Meteorology and Oceanography, NOAA, and was attended by officers from National Headquarters, from the Alaska, Pacific, and Western Regions of the U.S. National Weather Service, National Ocean Survey, and Joint Tsunami Research Effort of Environmental Research Laboratories.

Agenda

1. Program Management

- 1.1 Review present management structure
- 1.2 Define responsibilities of NWS Headquarters, Regional Headquarters and the ITIC
- 1.3 Financial accountability and reporting

2. Operations and Maintenance

- 2.1 Observatory functions and responsibilities
- 2.2 Tide stations
- 2.3 Seismograph Stations

3. TWS Automation

4. International Cooperation

- 4.1 Intergovernmental Oceanographic Commission, ITSU and ITIC
- 4.2 US/USSR Environmental Protection Agreement
- 4.3 Bi-lateral arrangements
- 4.4 Joint Tsunami Research Effort

5. Preparation of Revised Operations Manual Chapter

6. Preparation of Program Development Plan

7. Personnel

- 7.1 Professional Development and recognition
- 7.2 Mobility
- 7.3 Requirements

INTERGOVERNMENTAL OCEANOGRAPHIC COMMISSION AND UNITED NATIONS

International Tsunami Meeting

UNESCO's Intergovernmental Oceanographic Commission has announced that the Fifth Session of the International Co-ordination Group for the Tsunami Warning System in the Pacific, (ITSU-V) will be held in Lima, Peru, on the 23-27 February 1976.

Invitations for participation have been sent to the fifteen ITSU member states: Canada, Chile, China, Ecuador, France, Guatemala, Japan, Korea, New Zealand, Peru, Philippines, Singapore, Thailand, USA, and USSR. In addition, invitations have been sent to Mexico and Fiji, scientific advisory bodies of IOC, the Secretary General, WMO, the Presidents of the IUGG Tsunami Committee, and the Pacific Science Association, to the Director of the Regional Centre of Seismology for South America (CERESIS), to national contacts of the International Group, to the Chairman and Vice-Chairman of the Commission, and to a number of observers.

A provisional agenda for the meeting has been approved which will consider, among other things, the implementation by ITIC of resolutions adopted at the fourth session of the IOC Executive Council, in Ottawa, 17-22 June, 1974. The meeting will review the operations of ITIC and the Tsunami Warning System for the past two years, and recommend policies that will guide the future development of the System and its service to the Pacific community.

Annotated Provisional Agenda

1. Opening of the session

The session will open at 10.00 on Monday, 23 February 1976, at the Centro Regional de Sismologia para America del Sur, av. Arenales, 431, Lima, Peru. English and Spanish interpretation will be provided.

2. Adoption of the agenda and election of a rapporteur

A Provisional Agenda has been distributed with circular letter no. 541, dated 29 August 1975, as doc. IOC/ITSU-V/1 prov.

Whilst the Deputy Secretary IOC remains responsible for the report of the meeting, it would still be appreciated if a rapporteur could be elected from the participants, in order to keep a continuous record of the discussion.

3. State of implementation of res. VIII-24, and of recommendations from the fourth session of ICG/ITSU, held in Wellington, New Zealand, February 1974.

Res. VIII-24 was approved at the eighth session of the IOC Assembly, Paris, 5-17 November 1973; the recommendations of the fourth session of ICG/ITSU were approved by the Executive Council of the Commission, at its fourth session, in Ottawa, June 1974. The relevant resolution, EC-IV.6 will be considered under Agenda item 4 below.

The Chairman, with the assistance of the Secretary, will report on the state of implementation of res. VIII-24 and of the recommendations of the fourth session of ICG/ITSU.

4. Consideration of IOC resolution EC-IV.6 concerning ITSU, adopted by the fourth session of the IOC Executive Council, Ottawa, 17-22 June 1974

Resolution EC-IV.6, in its 8th paragraph, approves the report and recommendations of the fourth session of ICG/ITSU. Representatives of Member States will be invited to report on their use of existing radio and other telecommunication channels including high frequency radio, in the Tsunami Warning System (4th paragraph). The Director of ITIC will be requested to inform the session of his contacts with ICSU on the data archival and exchange requirements of the TWS (6th paragraph) and the representative of ICSU will be asked to introduce details of the proposed revisions to ICSU procedures for the archival and exchange of tsunami related data, as requested in paragraph 7. Matters concerning the appointment of an Associate Director of ITIC (paragraphs 10 to 12) will be dealt with under agenda item 5, below.

In this connection, reference is made back to resolution VIII-24, adopted by the eighth session of the IOC Assembly, Paris, 5-17 November 1973, the 2nd part of the penultimate paragraph of which, concerning assistance from the United Nations Development Programme, remains unimplemented. The Director of ITIC, in the meantime, has taken up this matter with several countries and will report on the results of his discussions under agenda item 5 below.

5. Report by the Director, International Tsunami Information Center (ITIC), Honolulu

The Director ITIC will present a report on the activities of his Center for the last two years, and will touch on questions concerning the new post of Associate Director of ITIC, and his discussions in Member States, in particular regarding project funding from the UNDP.

Under this item, the Group is invited to consider the duration of the post of Associate Director. The present appointment of Dr. Wigen from Canada to this post is initially for one year only, and this may be considered to be too short (ref.: letter of the Chairman of ITSU, dated 7 January 1975, to the Director of ITIC).

6. National reports on current tsunami research and instrumental developments

The representatives of Member States are invited to report on latest developments in their respective countries. Each speaker is requested to provide a short summary of his statement in not more than 3 pages (and if possible in Spanish and English) to the Secretary for distribution during the session.

7. Consideration of recommendations from the IUGG Tsunami Committee meeting, held in Grenoble, France, August 1975.

The Chairman of the Committee will be invited to introduce any recommendations related to ITSU adopted at the above meeting.

8. Consideration of UNCTAD resolution 108 (XIV) of 12 September 1974.

This resolution (copy attached at Annex II) was brought to the attention of the Commission by the Secretary-General of UNCTAD, Mr. Gamani Corea, on 3 February 1975. It will be noted that the second operational paragraph requests international organizations "to intensify efforts to help to resolve the problems of particular importance to developing island countries, especially the problems associated with.....the effects of natural disasters". The Group is invited to consider this resolution.

9. Proposals for further expansion of the Tsunami Warning System.

The Director ITIC will be invited to report on progress made (ref. recommendation ITSU-IV.2). The Associate Director informed the IOC Secretary, by letter of 20 May, that the Director and he have begun preparation of a master plan for the TWS; the Director or the Associate Director of ITIC are invited to present this plan to the Group.

10. Proposals for further improvements in communication including standardization of information exchange and dummy tests.

The Director of ITIC will be invited to report on the latest developments. Recommendation ITSU-IV.3 (Wave reporting procedures) refers.

11. Proposal for a Pilot project on study of the damage caused by tsunamis on the Western Coast of South America (Unesco doc. 18 C/5 para. 2395)

The Delegate of Peru to the 18th Session of the General Conference of Unesco proposed that Unesco, through its IOC, implement the above project. The representative of Peru will be invited to elaborate on this idea, and to present a draft plan.

12. State of preparation of educational material to raise public awareness of the danger of tsunamis.

The Secretary will report on this subject.

13. Other matters.

Participants are requested to bring up other matters they may wish to have included, during item 2, when the agenda is adopted.

14. Date and Place of the sixth session of ICG/ITSU.

Representatives of Member States are requested to consider inviting the Group for its next meeting, to be held in early 1978.

15. Adoption of the Summary Report and Recommendations.

16. Closure of the session.

NATIONAL AND AREA REPORTS

July 21, 1975 Solomon Sea Earthquake

(ITIC was pleased to receive from Dr. I. B. Everingham this detailed account of the July 21 tsunami. Contrary to what was reported earlier, the tsunami did not cause loss of life.)

Following the earthquake of July 21, the sea surged inland several times along about 80 km of the south-western and southern coasts of Bougainville with an amplitude up to 2 metres and period in the range 5 to 15 minutes. The tsunami occurred during the period of high tide, 1.2 meter, so that its effects were amplified.

Villagers at Mamagota village, on the southern coast, reported that the waves rose into the bush and made the river flood and subsequently change its course at the mouth. This village had recently been relocated about one kilometre inland because of several recent tsunamis. The earthquake collapsed 3 houses of a total of 12 in the village. The wave did not reach the village where it now stands, but probably helped in the destruction of one solitary village-styled abode at the beach. Evidence in the form of swept vines and grass and leaf strandlines indicated that water had risen at least one metre above the high water level at the time of the tsunami. Coarse beach sand particles trapped in the elevated end of a log also evidenced a wave greater than one metre above high water level; the other end of the log was firmly embedded in the beach sand.

The local hydrologist reported that stream gauging instruments which were located up the Jaba River 7 km from the coast showed more than a two metre rise in the stream just after the earthquake. There were no reports of rain in the area for the past week prior to the earthquake.

Several waves with a 10 cm amplitude were recorded at 15 minute intervals at the Loloho wharf near Kieta soon after the earthquake. Considering the geographical position of Kieta with respect to the epicentre, it can be seen that the tsunami waves were diffracted around the south-east coast of Bougainville.

Tsunami at Torokina

The tsunami was not observed by many Europeans. The Post and Telegraph (P & T) operator at Torokina moved inland from his house before the wave arrived. The people in the area expected a sea wave because they had also experienced a tsunami from the July, 1971, and February, 1974, earthquakes.

The local people saw the wave coming, about 15 minutes after the earthquake. They described it as a long low hump, stretching from north to south. At this stage most of the villagers departed into the bush.

One young man climbed a coconut palm and the wave passed under him. He said that the wave rose fairly quietly and that he could run faster than the speed at which it crossed the beach. On the other hand, other villagers said that the wave crossed the beach like a breaker, and that it moved faster than they could run. In general, it was agreed that had they been caught in the wave, they would have probably been drowned. About half of the village chickens and several dogs disappeared as a result of the tsunami.

The villager who had climbed the palm remained there for about 10 minutes. He reported that the first wave came through at a height of about one metre above ground level. The water level then seemed to remain high until a second larger wave arrived 5 minutes after the first. About 5 minutes after this wave, he climbed down from the palm tree and ran through ankle deep water to the safety of slightly higher ground. A third and smaller wave followed shortly thereafter.

Some of the people then returned to the village. A fourth wave came in at about ankle height but this did not worry the people who had returned.

A small light kitchen was washed behind the village into a swamp and smashed. Two houses were taken off their stumps by the wave, apparently the second wave, and moved about 30 metres inland. Canoes on the beach were carried about 50 metres to the rear of the village.

In the P & T station, water marks were visible at various heights, to maximums of 170, 173 and 177 mm at various localities. Inside the P & T building the marks formed by horizontally placed grass cuttings were fairly straight. On the building outside, the top mark at 177 mm was choppy with a wave length of about 25 mm, with straight water marks left at various levels as the water receded.

A pile of drums, some empty and others full, was moved completely from where they were stored. The furthest they travelled was about 60 metres. Many were caught in the corner of the cyclone wire fence around the site. Others drifted past the fence which was flattened at the rear of the building. Missing drums were probably washed out to sea.

The tsunami moved in at right angles to the coast line. Torokina Mission was protected by a 2 metre high bar with a creek behind it. A considerable quantity of water passed over the bar into the creek, but the landward side of the creek was not affected.

The water swept into the village, which is only about 0.5 metre above high water level. It penetrated into the swamp behind the village for possibly 0.5 km but did not leave much evidence of its presence. The P & T station was fairly protected from the south and south-west, but the water seemed to have filled the bay to the north of the station, and the water spread over the station largely from the north-west. It did not appear to have travelled more than about 90 metres inland of the station. The only signs of the wave inland of the station were, swept over grass, and small piles of grass debris against the stronger bushes. In some places where the ground had been covered with vine-like material, the tsunami uprooted and rolled back this cover leaving bare ground.

When trying to judge the height of the wave from waterline marks on the P & T buildings, it must be noted that the buildings subsided about 250 mm. Most of this subsidence probably took place during the main earthquake, before the tidal wave. However, some subsidence almost certainly occurred during the strong aftershocks - notably those about 9.30 am and 12.30 pm on the 21st.

Another factor to be considered is that the whole sandy area on which the station is built seems to have sunk about 150 mm. This effect can be seen by observing the drop around the P & T towers, which have been built on pilons which were sunk to bedrock to a depth of 36 metres.

No loss of life was reported due to the tsunami.

U.S.S.R./U.S.A. Kuril Tsunami Experiment

The field work of the Kuril tsunami measurement program has been recently completed. During August and September, Dr. Robert Harvey and Mr. Donald Shinmoto of the University of Hawaii's Joint Tsunami Research Effort (JTRE) worked on the Soviet research vessel, Valerian Uryvaev, making free vehicle measurements. Nine bottom pressure recorders, a vertical electric field recorder and an ocean bottom seismometer were deployed along the coast of Hokkaido and the southern Kuril Islands.

JTRE reports that good data records were obtained from most of the instruments, but no large tsunami occurred during those months. However, much useful information will be obtained about tsunami background noise, trapped waves along the continental boundary and the local tides in deep water, uncontaminated by shore interactions.

At the completion of the shipboard work, Dr. Gaylord Miller and Dr. Harvey proceeded to the Sakhalin Complex Scientific Research Institute, where they spent three weeks working on data analysis and writing a joint report with Dr. Sergei Soloviev, Dr. Sergei Lappo, and the other Soviet scientists. Further data analysis is now in progress both at JTRE and Sakhalin. In conjunction with this work, Dr. Vladimir Efimov will be visiting JTRE in February.

Philippine Islands Earthquake

An earthquake measuring 7.4 on the Richter scale occurred October 31 in the Philippine Islands, with the epicenter northeast of Samar Island. A tsunami was generated, and registered a maximum wave height of 10 cm at the Okinawa gauge, 6 cm at Yap, and 6 cm at Wake Island. ITIC has received no reports to this date of wave heights or impact on the adjacent Philippine Islands coast.

ABSTRACTS AND RESUMES OF RECENT PUBLICATIONS RECEIVED AT ITIC

Earthquake and Tsunami Hazards in the United States: A Research Assessment

Robert S. Ayre, Dennis S. Mileti and Patricia B. Trainer
Institute of Behavioral Science #1
University of Colorado
Boulder, Colorado 80302

This monograph is one of a series, The Assessment of Research on Natural Hazards, intended to serve two purposes:

- (1) Provide a more nearly balanced and comprehensive basis for judging the probable social utility of allocation of funds and personnel of various types of research on natural hazards.
- (2) Stimulate, in the process, a more systematic appraisal of research needs by scientific investigators in co-operation with the users of their findings.

In six chapters the book defines the dimensions of the earthquake problem and tsunami hazard in the United States, simulates earthquake and tsunami loss

management, and reviews and recommends alternatives in research. For both of these dangers the need being considered is not for geophysical research but for research related to hazards to life and property.

Faulting Associated with the Major North Solomon Sea Earthquakes of 14 and 26 July 1971

I. B. Everingham
Geophysical Observatory
Port Moresby, PNG.

Reprint from Journal of the Geological Society of Australia, Vol. 22, Pt. 1, pp. 61-69, March 1975.

Major tsunamigenic earthquakes occurred on 14 July and 26 July 1971 about 100 km apart in the north Solomon Sea. The second earthquake is not considered to be an aftershock of the first: aftershock patterns and fault-plane solutions indicate that both were the result of movements along two separate parts of a major arcuate fault surface. The first earthquake caused movement along the part of the fault that extends south-southeast, the second in the part that extends west-southwest, from southernmost New Ireland.

The two aftershock zones overlapped to the south-southeast of New Ireland near the epicentre of the 26 July earthquake and where its fault rupture commenced. The rupturing was probably due to the effects of the 14 July earthquake series.

Aftershock and first-motion data indicate that the area between Bougainville Island, southern New Ireland, and southeastern New Britain is being underthrust from the south. The fault surface appears to be concave downwards, with depth and dip increasing towards the islands to the northwest, north, and northeast.

During both earthquakes, intensities of at least MM8 were experienced; their isoseismals form ellipses whose long axes coincide with the trend of the relevant aftershock zone (i.e., south-southeast for the first earthquake, west-southwest for the second). Maximum intensities apparently occurred above the aftershock region.

Evidence suggests a surface-wave magnitude of 8.0 for both earthquakes.

United Nations Assistance in the Establishment of Tsunami Warning Systems in Developing Countries: Guidelines for a Project Proposal

George Pararas-Carayannis
International Tsunami Information Center
P.O. Box 3650
Honolulu, Hawaii 96811

Copies available on request.

At the fourth meeting of the Intergovernmental Oceanographic Commission's (IOC) International Coordination Group for the Tsunami Warning System in the Pacific (ICG/ITSU), Wellington, New Zealand, February 4-7, 1974, it was recommended that the Director of the International Tsunami Information Center (ITIC) should advise

the Governments of developing countries on sources of international funds for setting up their own national tsunami warning systems. Furthermore, it was suggested that an action plan be provided for establishing national warning systems and for participation in the International Tsunami Warning System.

This recommendation was officially adopted at the fourth session of the Executive Council of the Intergovernmental Oceanographic Commission which met in Ottawa, Canada, June 17-22, 1974. The ITIC's functions were expanded to give technical advice on the equipment required for an effective warning system and to provide assistance in the establishment of national tsunami warning systems.

IOC's International Tsunami Information Center (ITIC), in accordance with these resolutions and in fulfillment of its responsibility to Member States of the International Coordination Group on the Tsunami Warning System in the Pacific, has prepared this report on technical assistance available from the United Nations system for support of National Tsunami Warning Systems, requested by interested developing nations. The report provides guidelines for the preparation and submission of project proposals, assistance available from the UN system, responsibilities of all contracting parties undertaking a project, technical advice, and procedures to be followed at all stages of project development and implementation.

The report was prepared with the assistance of Mr. Richard S. Farmer, Research Associate at ITIC, and is based on an extensive research and review of United Nations documents, publications and other materials with a view to understanding particularly the structure and activities of the United Nations Development Programme, coordinating specialized agencies and UNESCO, for the purpose of providing guidelines for project design and development.

An Analysis of the Conventional Tide Well

R. D. Braddock
Department of Mathematics
University of Queensland
St. Lucia, Queensland 4067

Applied Mathematics Reprint No. 86

Recent uses to which tide gauge records have been put has revealed that modern analytical and computing techniques have outstripped the quality of the available data. Lack of knowledge of the response of the conventional tide well has handicapped research in the interpretation of tide and tsunami records. In this paper, the dynamics of the basic tide well is discussed and an energy equation for the flow is developed. This equation includes the effects of viscosity and turbulence in the flow.

The nature of the solutions to the tide well equation are discussed particularly with reference to the 'steady state' response to a sinusoidal input. It is found that the tide well is essentially non linear for disturbances having periods typical of tsunamis. For tidal periods, the basic equation is essentially linear with small order corrections provided by the non linear terms. Transient effects are also considered and these give rise to a variety of time scales. The transient response is discussed in relation to the recording of tsunamis.

The Tides of the Continent of Australia

A. K. Easton

Horace Lamb Centre for Oceanographical Research
Flinders University of South Australia
Bedford Park, South Australia

Australia's local and zonal tidal phenomena are described on the basis of all previously known and newly gathered tidal data. The historical development of the study of its tides is traced from the first visits of mariners to the most recent harbour developments. By means of a station to station correlation technique, the Australian coast is sub-divided into zones, each with a specially selected standard port and a distinct tidal character. Tidal phenomena and mean sea levels and their relationship to meteorological effects are discussed within this framework.

ANNOUNCEMENTS

Joint Oceanographic Assembly

A Joint Oceanographic Assembly to be held in Edinburgh, Sept. 13-24, 1976, is reported by the International Marine Science Newsletter. The programme will consist of general and specialized symposia, and 11 sessions organized by IAPSO (International Association for the Physical Sciences of the Ocean), IABO (International Association of Biological Oceanography) and the CMG (Commission for Marine Geology), many of which will be open for offers of contributed papers.

Pre-registration and requests for further information should be sent to: The Organizing Committee, Joint Oceanographic Assembly, c/o The Royal Society of Edinburgh, 22 George Street, Edinburgh EH2 2PQ, Scotland, U.K.

15th International Conference on Coastal Engineering

Organizers of the conference, to be held in Honolulu, July 11-17, 1976, report that 500 papers have been offered, but of these only 200 can be selected for presentation. Papers to be given at the tsunami session of the Conference have not yet been announced.

For Conference information, write:

Professor Charles L. Bretschneider
Chairman, Organizing Committee, COASTAL-76
Dept. of Ocean Engineering
University of Hawaii
2565 The Mall
Honolulu, Hawaii 96822

Geodetic Measurements in the Ocean

June 28-30, 1976. Urbana, Illinois.

The conference program announced in the September ITIC Newsletter has been expanded to include a session on tsunamis.

Keynote Speech

Ocean Bottom Topography and Mapping

Positioning and Navigation

Industrial Needs and Requirements

Tsunamis

Mean Sea Level

Instrumentation - Sonar Systems

- Space Systems

Plenary Session

A.G. Mourad

S.E. Drummond Jr.

R.C. Munson

G.A. Zahn

T.S. Murty

S.W. Henriksen

K.V. MacKenzie

R. Anderle

N.K. Saxena, A.G. Mourad

and Panel Chairman

For further information contact Professor N.K. Saxena, Department of Civil Engineering, University of Illinois, Urbana, Illinois 61801.

Tsunami Records

Commencing in January 1976 the International Tsunami Information Center will seek to correlate as complete a record as possible of tsunamis generated in the Pacific region. We will appreciate receiving from gauging authorities in all countries copies of analogue records of any tidal stations showing evidence of a tsunami. The record should include a period from 25 hours before the arrival of the initial wave, to a time at least 25 hours after the arrival, or as long as the tsunami is identifiable on the record, whichever is greater. The pre-tsunami record is used in identifying long waves that may have modified water levels during the tsunami.

ITIC will extract basic data from the records for cataloguing and publication, and will promptly forward any record with evidence of the tsunami to the World Data Center, for retention and dissemination to researchers.

As time permits ITIC will endeavor to collect similar records for previous tsunamis, that have not already been catalogued or published.

Traditionally, standard tide gauge stations have been the source for systematic information on tsunamis. With the increasing cost of data processing in many countries, a trend is developing to convert tide stations from continuous recording to some form of water level sampling at fixed time intervals, with the data being registered in some computer compatible format. Although such records meet the principal requirements for tidal data they do not record information essential to tsunami analysis. This impending conversion to intermittent sampling lends an urgency to compiling tsunami data now.

In line with the international trend toward metrication, ITIC will as much as possible use metric units in future reporting.

Wanted: Photographs of Tsunami Waves and Effects

World Data Center A for Tsunamis is compiling a collection of photographs of tsunami waves and their effects, as a valuable form of data. Readers with photographs or

slides they are willing to share are requested to contact Mr. Jerry Coffman, WDC-A, NOAA/EDS, Boulder, Colorado, 80302.

WDC-A is willing to copy and return loaned original photographs, to reimburse contributors for the cost of reproduction, or to make available to contributors an equivalent number of photographs from its collection.

Selected photographs will be cataloged and made available to requestors at the cost of reproduction. A Catalog of Earthquake Photographs is presently available on request. Credit for the source of the photographs is given for each one distributed. Captions are required.

CONFERENCE REPORTS

Typhoon Committee Meets

The eighth session of the Typhoon Committee, sponsored by two United Nations organizations, Economic and Social Commission for Asia and the Pacific (ESCAP), and World Meteorological Organization (WMO), was held November 11-17, in Bangkok.

Although not directly concerned with tsunamis, the Committee's involvement with disaster preparedness is relevant. Among its programs for 1976 is the preparation of Guidelines on Community Preparedness and Disaster Prevention: Measures to Reduce Loss of Life and Damage caused by Tropical Cyclones and Associated Floods. Regional seminars are being planned on this theme in member countries.

Special attention is being given to stimulating research in objective typhoon and storm surge forecasting. The Committee encourages the use of meteorological buoys in deep ocean, transmitting data via satellite, and these may have potential application in the early detection of tsunamis.

Maritime Satellite System Endorsed

Unesco's International Marine Science Newsletter reports that an international conference, convened by Inter-governmental Maritime Consultative Organization (IMCO) 23 April - 9 May, has agreed that a world-wide maritime satellite system should be established which would be administered and managed by an inter-governmental body (INMARSAT).

Delegates from the 45 participating nations also set forth certain general principles concerning the designation by a member state of national entities (agencies) which would enjoy the rights and fulfill the obligations in the proposed new body.

The development of space technology for maritime purposes has been under consideration within IMCO for nearly a decade. Following a decision of principle in 1966 and certain preparatory work, an IMCO panel of experts was set up in 1972 to study the value of the proposal.

The conference based its deliberations on a report of the expert panel, and discussed many of the administrative questions. To complete its work, the conference decided to reconvene at a second session to be held in London in February 1976.

HONOLULU OBSERVATORY REPORTS

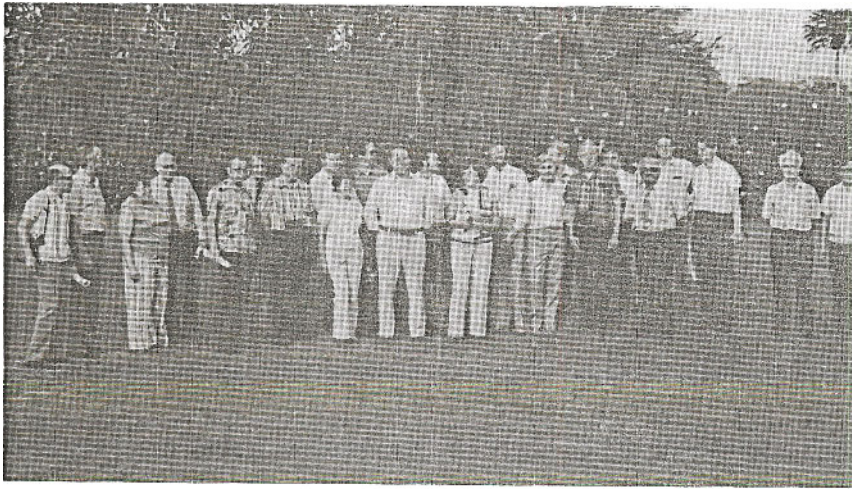
Soviet-American Scientists Tour Honolulu Observatory

ITIC's Honolulu Observatory, Operational Center of the International Tsunami Warning System, at Ewa Beach, Oahu, was visited on October 23 by a joint American-Soviet delegation of scientists attending the Comprehensive Analysis of the Environment Symposium here in Hawaii. The group of scientists was escorted from the Kahala Hilton, in Honolulu, to the Observatory by the Director and Associate Director of ITIC, Dr. George Pararas-Carayannis and Mr. Sydney Wigen, respectively, and by LTJG Dennis Sigrist, Assistant Tsunami Specialist. Mr. Tom Sokolowski, senior geophysicist at the observatory, conducted an informal tour of the facilities for the visiting guests.

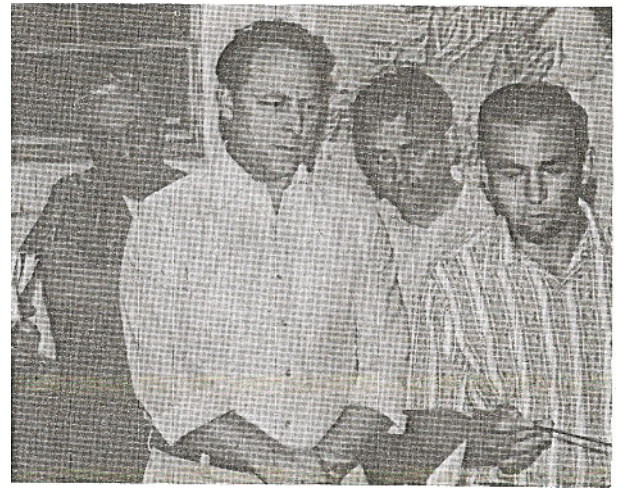
The group consisted of 14 Soviets and an equal number of U.S. experts who were meeting in Honolulu as part of the working group VII-II, of the US/USSR Joint Agreement in the Field of Environmental Protection. The visiting scientists were representing different disciplines, but they were most interested in the facilities of the observatory complex located 25 miles from downtown Honolulu. Academician Yu. A. Israel, spokesman for the group, and head of the USSR Hydrometeorological Service, presented George Pararas-Carayannis an inlaid wooden plaque, now on display at ITIC, in remembrance of the occasion. Upon completion of the visit to Honolulu Observatory, the group continued its tour among the Hawaiian Islands.

Seismic Summary

<u>Date and Origin Time (U.T.)</u>	<u>Epicenter</u>	<u>Magnitude</u>	<u>Region</u>	<u>Comments</u>
Oct 1 0330Z	4.9 S 101.6 E	6.9	Sumatra	Press Release
Oct 6 2224Z	12.5 S 166.7 E	7.0	New Hebrides	" "
Oct 11 1435Z	25.3 S 174.9 W	7.3	Tonga Is.	" "
Oct 31 0830Z	13.0 N 126.2 E	7.4	Philippine Is.	" "
Nov 29 1448Z	19.4 N 155.1 W	7.2	Hawaii	Local Warning
Dec 26 1556Z	15.5 S 172.0 W	7.2	Tonga Trench	Watch Issued



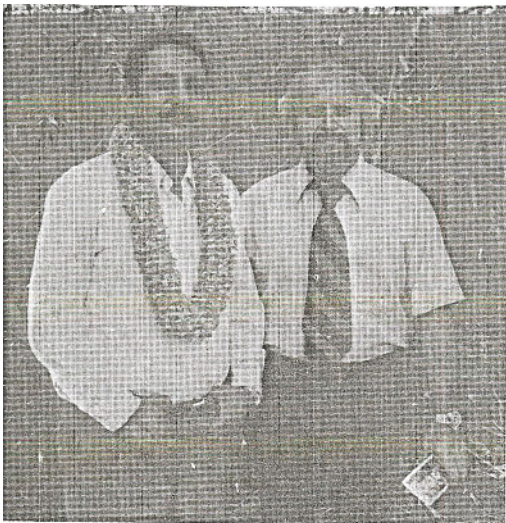
Visiting USSR/USA Environmental Delegations on the grounds of ITIC's Honolulu Observatory during a recent visit.



Mr. Tom Sokolowski, Senior Geophysicist, Honolulu Observatory, explaining the ITIC Tsunami Warning Center's seismographs to Academician Israel, head of the USSR Hydrometeorological Service, and other members of the USSR/USA visiting delegations.



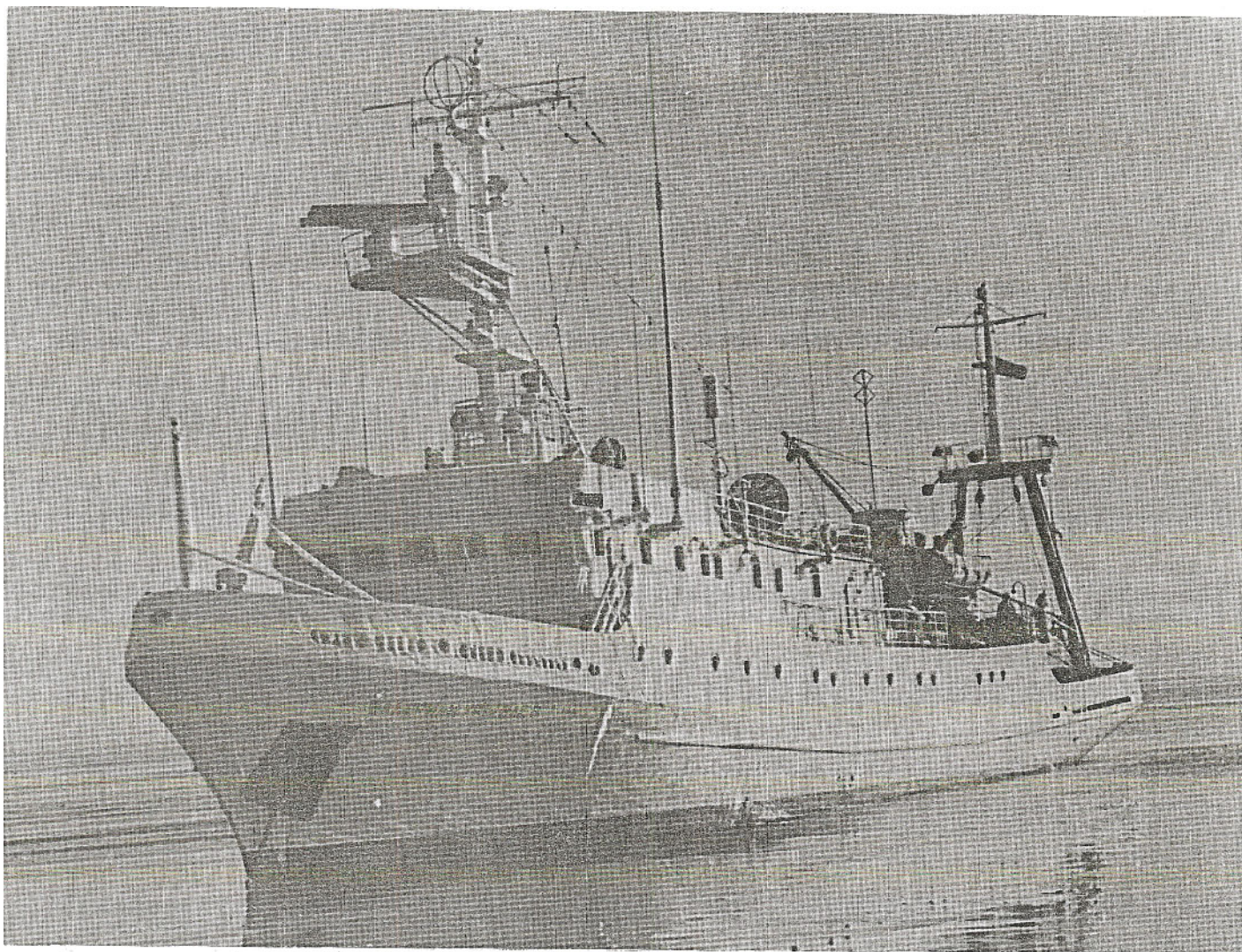
RADM H.R. Lippold, Director, Pacific Marine Center, 2nd left, and Mickey K. Moss, Assistant Chief, Pacific Tide Party, 2nd right, recently toured the facilities at HO(G). Dr. George Pararas-Carayannis, Ms. Wilda Mazey, and Mr. H. Wirz, were on hand to greet the visitors.



Dr. George Pararas-Carayannis, Director, ITIC, welcoming Mr. Cesar Vargas, ITIC visiting scientist, under the auspices of the Intergovernmental Oceanographic Commission, at Honolulu International Airport.



Visitors at HO(G): Mr. H. Wirz, far left, Chief, HO(G), conducting tour of (to the right): Dr. A. Ivanchenko, USSR scientist; Mr. C. Vargas, Peru scientist; Dr. George Pararas-Carayannis, Director of ITIC; and Mr. S. Wigen, Associate Director of ITIC.



The Soviet research vessel VALERIAN UZYVAER which participated in the joint USSR/USA Kuril Tsunami Experiment. Dr. Robert Harvey, Mr. Donald Shinmoto, of the Joint Tsunami Research Effort, worked with Soviet scientists in deploying ocean bottom seismometers and wave recorders from this vessel.



Tsunami Coordination Group Conference December 8 through 11. Members in attendance top row, from the left: Mr. H. Wirz, Chief, HO(G); Dr. G. Flittner, Director, Ocean Services Div, NWS Hqs; Mr. M. Moss, Asst Chief, Pacific Tide Party; Dr. G. Miller, Director, Joint Tsunami Research Effort; and Mr. C. Woffinden, Director NWS Pacific Region. Bottom row from the left: Mr. R. Eppley, Chief, Palmer Observatory, Alaska; Mr. S. Wigen, Associate Director, ITIC; Dr. G. Pararas-Carayannis, Director, ITIC; Mr. S. Bigler, Director, NWS Alaskan Region; Mr. P. Williams, Chief, Meteorological Services Division, NWS Western Region; and Mr. M. Spaeth, Tsunami Specialist, NWS Hqs.